MEDICOLEGAL ASPECTS OF INTRAPARTUM MONITORING: A SHORT SERIES

by DAVID T. ARMITAGE, M.D., J.D., COL, MC, USA

PART TWO OF THREE

An important goal of intrapartum monitoring is preservation of fetal well-being by early detection and relief, when possible, of those conditions causing fetal distress and adverse outcomes. Intrapartum monitoring requires attending to the parturient patient to detect conditions potentially harmful to the fetus or the mother. An accelerating rise in maternal blood pressure, for example, suggests the onset of a severe disorder which could be injurious to both mother and fetus. Fetal parameters may reflect and be modified by maternal parameters. A fever in the mother may lead to tachycardia in the fetus. This tachycardia could compromise some fetuses yet be tolerated by others.

Intrapartum monitoring, then, involves surveillance of the physiologic state of the mother and fetus, and the nature of the labor process. There are established *ranges* of normal for: duration of various stages of labor in nulliparous and multiparous patients; rates of dilatation and effacement of the cervix; rates of progress in the intensity and duration of uterine contractions and periods of rest between contractions; quantitative as well as qualitative changes in fetal heart rates; progress in descent and orientation of the presenting part; fetal scalp blood pH; and for the amount, nature, and status of amniotic fluid. Proper surveillance facilitates detection of abnormalities which could reflect developing problems. For example, an episode of hypotension in the mother with an alteration in the fetal heart beat might be managed simply by turning the patient on her side, a well-known first-level intervention to correct certain abnormalities (e.g., hypotension, fetal tachycardia) once detected by competent surveillance.

MONITORING RESPONSIBILITIES

In the military health care system, the overall responsibility for a patient in labor rests with the attending physician. This responsibility cannot be delegated to a nurse midwife or to an obstetrical nurse, although certain responsibilities and functions can be carried out by each. It is recommended that the limits of practice and the scope of responsibility of these providers be detailed in writing. A guide to fetal monitoring written for nurses (Tucker, 1988) states, "The nurse who develops expertise in [electronic fetal] monitoring and pattern recognition is held responsible for this expertise. After identification of a nonreassuring pattern, the nurse's responsibility does not cease with nursing intervention alone. The attending physician must be notified and respond to the emergency nature of the situation. *Should the physician be unfamiliar with monitoring, the nurse must follow hospital protocol for dealing with this situation."* [Emphasis added.]

The emphasized sentence seems unnecessary. It should be obvious that no physician should attend a patient in labor using monitoring methods and technology with which he is unfamiliar. Nevertheless, in one military health care facility a few years ago, a nurse telephoned the obstetrician on call because she was concerned about the electronically monitored fetal heart rate pattern. The obstetrician, attempting later to defend his management of the labor, which concluded in an adverse outcome, stated that he did not respond sooner because he was unfamiliar with electronic fetal monitoring and did not realize the implication of what the nurse had related. While this may be an extreme example, the quote from the nurse's guide implies that, at least in the experience of that author, there have been unskilled physicians charged with monitoring obstetrical patients. This is unacceptable. Health care providers must be able to provide the care, expertise and supervision expected of professionals at their levels of practice.

In exercising their responsibilities, physicians are encouraged to respectfully consider the expressed concerns of subordinate staff. Cases involving neurologically damaged babies are difficult to defend when nurses, concerned about a patient's status, have requested review and assistance from an attending physician who was neither cordial nor timely in response.

LENGTH OF LABOR

It may be alleged in a malpractice case that a prolonged stage of labor should have alerted medical staff that a preventable injury to the fetus was imminent. For any patient, the problem of determining the length of labor, especially that of the first stage, relates to the difficulty in establishing the onset of labor. To make matters worse, a variety of observers (physicians, nurses, aides) may note different times in the medical record for onset of labor. The attending physician should detect those discrepancies and document the basis for their reconciliation. Alternately, he should note the basis for his final conclusion as to the most likely time of labor onset if discrepancies can not be resolved. Documentation reflects the fact that the issue was considered. It makes the reasoning behind the physician's judgment available for other staff monitoring the same labor. In addition, that reasoning is preserved should timing become a disputed issue years later when memory has faded.

Monitoring the progression of labor through all stages is inherently complicated because of a high degree of physiologic variability (Bennett, 1989). Emanuel Friedman (Zlatnik, 1990) conducted the seminal studies of the duration of labor. These studies can provide assistance to those monitoring labor in evaluating the normality of progression. Friedman's curves show mean, median, and mode of each stage of labor for both nulliparous and parous patients. Upper limits of normal are also displayed, along with the rate of cervical dilatation in centimeters per hour. The latent phase in stage I labor for a nulliparous patient may be as long as 20 hours and can be followed by a 12 hour active phase, although the mean durations are 8.6 hours and 4.9 hours respectively. Obviously, there is a wide normal range. Within this range, one would not expect to find a problem with either fetal or maternal well-being. Nevertheless, it is recommended by the American College of Obstetricians and Gynecologists (ACOG) that the medical staff of every delivery facility establish time limits for the various stages of labor beyond which an assessment of the status of labor must be documented. Within any time limits accepted as "normal", labor must show continuing progress, especially after entering the active phase. The beginning of the active phase is easier to identify if a graph is constructed relating time and measurable labor parameters. The curve reflecting dilatation of the cervix assumes an S-shape, and its slope accelerates at the point when the active phase begins. Although this is a retrospective determination, it provides a more reliable point for recording the subsequent phases of labor.

An abnormal length of labor may suggest problems; however, the fact that a patient's labor falls within a normal time range does not necessarily imply that it is progressing satisfactorily. Attentive surveillance and careful analysis are necessary, not the mere notation of the duration of stages. Other factors involved in the labor, with the physiologic measurements mentioned, must be taken into consideration.

This article is not intended to be an in-depth or exhaustive analysis of the normal ranges for various monitored parameters. Skilled, attentive, competent staff caring for patients in labor utilize the aforementioned knowledge, and much more, in decision-making.

ELECTRONIC VS. CLINICAL MONITORING

Clinical monitoring and electronic monitoring are both generally accepted methods for intrapartum fetal surveillance, if done in conformity with accepted standards. Although intrapartum monitoring in the minds of many has come to mean surveillance of the fetal heart rate and uterine activity by an electronic device (Cunningham, 1989), true monitoring does not take place by machine. Even telemetry does not obviate the necessity for personal professional attention to the surveillance process. In fact, the presence of machines may mandate closer personal attention in order to overcome a natural tendency to rely on technology alone. A claim of obstetrical malpractice is difficult to defend when there are sustained abnormalities on a monitoring strip not acted upon because of inadequate surveillance.

Monitoring the fetal heart rate using the Delee-Hillis fetoscope or the Doptome was the usual method of fetal surveillance prior to the introduction of electronic monitors. Fetal tachycardia (above 160 beats per minute) or bradycardia (below 100 beats per minute) detected between uterine contractions, and the passage of meconium or meconium-stained amniotic fluid (in a cephalic presentation), were generally accepted as indications of fetal distress.

High risk pregnancies appeared to require more. In an effort to increase the predictability and early detection of fetal distress, methods were developed to continually monitor the fetal heart rate and its response to uterine activity. Internal and external methods were devised with different requirements for application, different data-generating profiles, and different risks to mother and fetus. A number of obstetricians, both in the United States and Great Britain, reported somewhat lower perinatal mortality rates for patients monitored electronically on a continuous basis. They had employed this technology mainly in cases involving complications of pregnancy likely to subject the fetus to an adverse outcome. Beard (1974), however, urged that electronic fetal monitoring not be limited to high risk pregnancies. His experience was that the number of fetuses suffering hypoxia and acidosis in so-called "normal" labors was the same as that in high risk pregnancies. It was his belief that only by monitoring all labors on a continuous basis could intrapartum hypoxia/acidosis and bad outcomes be reduced.

In 1968, Benson reviewed 24,863 labors monitored by fetoscope alone. He concluded that there was no reliable auscultatory indicator of fetal distress, except in the most extreme circumstances. Results from the initial studies of electronic monitoring demonstrated an improved outcome when compared to those of Benson. Benson's study, however, did not include fetal heart rate monitoring during the first thirty seconds after uterine contraction nor were similar assessments required every fifteen minutes during stage I and every five minutes during stage II (Cunningham, 1989). Subsequent studies (Haverkamp 1976, 1979) utilized protocols calling for such assessments, along with evaluation of uterine contractions by palpation and clinical observations of the mother. Apgar scores of a clinically monitored group were no different than those of a group that was continuously monitored electronically. The rate of cesarean section in a clinically monitored group was appreciably lower than that for those monitored electronically. Similar results were found by Levino (1986) when he compared the outcome of a group of pregnancies where all labor was monitored by continuous electronic means to that of a group where electronic monitoring was reserved for high risk pregnancies. His study confirmed that universal electronic fetal monitoring does not improve pregnancy outcome when compared to competent clinical monitoring.

In 1988, ACOG declared there was no evidence that listening to fetal heart tones at intervals longer than fifteen minutes during stage I in low-risk pregnancies is deleterious. Currently, ACOG recommends that, in the absence of abnormalities, the fetal heart rate is best checked after a contraction and at least every thirty minutes during stage I labor. For women with high-risk pregnancies, intermittent auscultation every fifteen minutes in stage I and every five minutes in stage II is an acceptable alternative to continuous electronic fetal monitoring.

Nonetheless, electronic monitoring is still the most frequently utilized approach in high risk pregnancies, probably because the seductiveness of "technology" continues to exert an effect in our litigious society. Consequently, Cunningham (1989) believes it is highly unlikely that there will be an abandonment of continuous electronic fetal monitoring. Cunningham's recent review of cases at Parkland Hospital in Dallas, Texas, revealed that about 60% of labors are monitored clinically. Continuous electronic fetal monitoring is reserved for special circumstances, including: variation in fetal heart rate detected by clinical monitoring when it is concluded that immediate delivery is not necessary; meconium in the amniotic fluid; induction or augmentation of labor with oxytocin; previous cesarean delivery; or, increased likelihood of ureteroplacental insufficiency and a compromised fetus secondary to pre-eclampsia, hypertension, bleeding, preterm/postterm pregnancies, intrauterine growth retardation, abnormal presentation, previously unexplained stillbirths, sickle cell hemoglobinopathies, hemolytic disease of the fetus, and maternal diabetes.

Cunningham acknowledges that the use of electronic fetal monitoring alone cannot be credited for any reduction in intrapartum or neonatal mortality at Parkland Hospital. He concludes that "[i]t cannot be overemphasized that the

techniques for continuous recording of fetal heart rates and uterine pressures cannot by themselves provide continuous surveillance of the fetus. Appropriately trained personnel must be immediately available to activate the electronic techniques, to inspect and analyze almost continuously the data that is being recorded, and to act promptly on the findings." Sometimes more time is spent in efforts to insure proper functioning of the electronic monitoring equipment than is actually spent in monitoring the patient.

SOME ISSUES IN ELECTRONIC MONITORING

The interpretation of electronic fetal monitoring data requires experience and judgment. There are generally agreed upon definitions as to what constitutes loss of beat-to-beat variability, periodic rhythm changes (late decelerations, variable decelerations), bradycardia, tachycardia, and long-term variability. Descriptive terms such as "prolonged", in reference to decelerations or loss of beat-to-beat variability, have also been standardized. It is also accepted that, properly calibrated and secured, the best data is obtained from *internal* electronic fetal heart beat monitoring by fetal scalp electrode combined with a functional intrauterine pressure catheter monitor. The calibration should be indicated on a strip recorded contemporaneously with the monitoring process.

Interpreting the data on the monitor strip, however, and determining whether such observations as loss of beat-to-beat variability are the result of fetal sleep or impending hypoxia/acidosis can only be accomplished with judgment and diligent attention to the entire labor process, i.e., with careful intrapartum surveillance. Other than perhaps prolonged profound bradycardia, findings on fetal monitoring strips bear no linear correlation with fetal outcomes. Experience has demonstrated that various patterns of deceleration, once thought to reflect dangerous hypoxia, only indicate possibilities. Absolute decisions should not be made merely on the basis of the presence of one pattern or another. Gilstrap (1987) has reported that fetal acidosis, defined by him as a fetal scalp pH of less than 7.2, was unlikely to occur as long as beat-to-beat variability was present. Cunningham (1989), however, points out that both fetal sleep and maternal medications may abate beat-to-beat variability. If beat-to-beat variability is an important monitoring parameter, only internal electronic monitoring regularly reveals its status, and its identification by external fetal monitoring is unreliable.

The nuances of interpretation are further illustrated by Cunningham's observation that a dead fetus may appear to be alive and bradycardic if the electronic monitor detects the maternal heart rate. He strongly recommends that, before any heroic treatment is undertaken on the basis of electronic monitoring, the fetal heart should be auscultated with an appropriate stethoscope while the maternal pulse rate is simultaneously monitored. An alternative is to look for fetal heart motion with real-time ultrasound.

What about the use of electronic fetal monitoring during one period of labor and clinical monitoring during another? For example, a patient with no high-risk antepartum conditions and a normal presentation of labor, with membranes intact, is admitted to the labor suite and placed on external monitoring for a period of time to determine the status of the fetus. Internal monitoring would not then be indicated. External monitoring, however, would have no advantage over clinical monitoring, because it does not provide reliable information on beat-to-beat variability. Nevertheless, some argue that temporary use of external monitoring after admission serves as a contraction stress test and provides prognostic information. This is not convincing, in view of the evidence that antenatal nonstress or contraction stress tests do not accurately predict ultimate fetal viability but merely reflect the condition of the fetus at the time of testing (Cunningham). More importantly, it is not reasonable to compare a test of fetal status in a patient who is not in labor to an assessment conducted on a patient in active labor.

If clinical surveillance indicates the labor is anything but normal, however, it is generally recommended that electronic fetal monitoring be continued until the attending physician is reasonably certain that the perceived variant is not a likely indication of a fetal problem. In most cases, "defensive medicine" results in continuous monitoring of a patient once monitoring begins. Practitioners know that it is not difficult for laymen, judges, lawyers and patients to believe that if

continuous electronic monitoring, once instituted, had been continued, fetal distress would have been detected and later neurological abnormalities avoided. Having connected patient and fetus to the monitor system because of irregularities detected clinically, the physician would later face the difficulty of arguing that, by disconnecting the electronic system and reinstituting clinical monitoring, he averted complications associated with electronic monitoring.

After being carefully labelled, electronic monitoring strips must be filed. Filing can be cumbersome and space-consuming. Sending strips to a central location does not guarantee their safe-keeping. Systems are available today to store monitoring data electronically. Although these systems are initially expensive, they may be cost-effective if they prevent loss of a subsequent malpractice case by preserving accurate, complete evidence of the obstetrician's sound judgement and reasonable practice. In some cases, cost can be reduced by adding a storage utility to a centralized monitoring system already in place.

In the final analysis, electronic fetal monitoring is a tool to be utilized by the "thinking monitor".

MECONIUM STAINING OF AMNIOTIC FLUID AS A MONITORING VARIABLE

In addition to parameters measured by electronic means and by auscultation, the staining of amniotic fluid by meconium has been interpreted, until recently, as an omen of adverse labor outcomes. How reliable is meconium staining of the amniotic fluid as an indicator of fetal distress or as an outcome variable? The answer is: not very.

There are different explanations for the passage of meconium, and the reason for meconium staining varies from case to case. Further, it may have several causes within the same case. As a result, there is no clearly established relationship between the passage of meconium and fetal outcome (Depp, 1990). Although meconium alone is not a reliable sign of fetal distress, its presence should stimulate the clinician to search carefully for additional indicia. Depp suggests that new, thick, particulate meconium passed for the first time in the second stage of labor, in association with prolonged, severe, variable or late fetal heart rate decelerations, is an ominous sign; but he offers no statistical support for this statement. Nevertheless, such a statement by an expert could weigh heavily in favor of a plaintiff, especially if other indications of potential distress were combined with a bad outcome. Zlatnik, however, has also pointed out that meconium staining is absent in a number of asphyxiated fetuses at term. He further notes that meconium staining is a very common event compared to "asphyxia." (Asphyxia is a poor term, as pointed out by many authors, because it technically means unconsciousness or death as a result of lack of oxygen). Although Zlatnik regards meconium-stained amniotic fluid as a soft indicator of fetal distress, recent studies have not found its presence to be associated with either abnormal heart rate patterns or acidosis at delivery. Nevertheless, he states, "Prudence demands continuous fetal heart rate monitoring in the presence of meconium staining." It is interesting to note that meconium staining is not listed in the ACOG Obstetric Criteria as a confirming criterion justifying cesarean delivery for fetal distress (ACOG, 1989).

FETAL SCALP PH AS A MONITORING VARIABLE

Fetal scalp blood sampling during labor, a procedure fraught with significantly greater problems than antecubital venipuncture in an ambulatory adult, has been advocated as another surveillance method in labors which develop nonreassuring fetal monitoring patterns or other indications of lack of fetal well-being. Even though the presence of late decelerations, customarily thought to reflect fetal hypoxemia, are found associated with normal scalp pH in 50% to 60% of cases, the clinical use of scalp blood sampling is based on the assumption that most cases of fetal acidosis are due to asphyxia (Depp, 1990). A scalp pH drawn during stage I is generally between 7.25

and 7.45. A value less than 7.2 is considered abnormal; one less than 7.16 is generally correlated with a low one-minute Apgar score. Depp states that a value less than 7.2 is an indication for delivery when there has been an abnormal fetal heart rate pattern, unless the pattern is improving. The clinician, however, should rule out a maternal contribution to a low fetal pH.

The fetal scalp blood pH issue is further complicated because abnormal monitor patterns *may* precede acidosis by a significant period of time. In addition, scalp pH may be normal in the presence of late decelerations because of the timing of the sample. If the scalp blood sample is drawn and the test performed correctly, the clinician may generally rely upon a reasonably normal value. But a normal value can give a false sense of security. Rapid onset hypoxia could occur after a recent normal value, and other signs of possible distress might be given less weight by the clinician. If the mother was hyperventilating when the sample was obtained, the fetus could still be hypoxic without being acidotic. In the opposite direction, a mother's acidosis could be reflected in the fetus which may, nevertheless, be normally oxygenated and uninjured by the acidosis. When baseline variability is poor, however, and there have been repetitive severe variable or late deceleration patterns during electronic monitoring, there is a high correlation with acidosis.

Fetal scalp blood sampling is not possible in all cases for a variety of reasons. Even when available, clinical decisions should not be based on a single value, unless that value is markedly abnormal. According to ACOG criteria, for example, a scalp pH less than 7.2 is a confirmation of fetal distress and justifies cesarean section.

Clark and Paul (1985) discouraged the use of fetal scalp sampling in general clinical practice. They state, "The properly trained clinician may pursue an approach for the detection of fetal distress that does not include scalp blood sampling without either compromising his ability to detect fetal distress or significantly increasing the cesarean section rate." This surveillance technique is a subject of continuing debate and requires judgment in both its use and interpretation.

THE APGAR SCORE

A favorite neonatal parameter used by attorneys to support an allegation of negligent monitoring is the Apgar score. The score was proposed in 1953 by Virginia Apgar, an anesthesiologist, as a method of assessing the ability of a newborn to respond to the demands of extrauterine life and the need for neonatal resuscitation. Early studies (later shown to have serious flaws) indicated that a low Apgar score correlated with subsequent neurologic deficit. More refined studies, however, have clearly shown that there is no correlation between later neurologic abnormalities and the one-minute or five-minute Apgar scores, although there is some correlation with future neurologic deficits when the Apgar at ten, fifteen, or twenty minutes is 0 to 3. Unfortunately, the Apgar score was incorporated by the International Classification of Diseases into its definition of asphyxia, with a one-minute score of six or less indicating mild to moderate asphyxia and three or less indicating severe asphyxia. The fact is, however, that the Apgar score is influenced by a variety of factors, including the subjective assessment ability of the evaluator, and a low Apgar score can result from circumstances other than perinatal hypoxia/acidosis (a better description than asphyxia). The Apgar score is not an etiologic statement about a newborn's condition. It is merely a status statement and a guideline for instituting necessary resuscitative measures to ensure the continued, immediate well-being of the neonate.

CONCLUSIONS AND COMMENTS

1) The goal of monitoring is to prevent adverse fetal outcome by the timely detection and treatment of fetal distress or conditions that could lead to fetal distress.

2) Intrapartum monitoring is a serious and complex process requiring diligence, knowledge, and skill.
3) There are no indications of fetal distress that are 100% foolproof.
4) A low risk pregnancy and early uncomplicated labor can develop into a high risk problematic labor, although such an event is unlikely.
5) Because of the unlikely adverse outcome of low risk pregnancies, the attending staff may be lulled into false security and fail to follow the principles of diligent intrapartum monitoring.
6) There is little likelihood of an adverse outcome with a competently monitored, low risk pregnancy. However, adverse outcomes occur in low risk pregnancies. Consequently, minor breaches of attention to the patient or documentation may support an allegation that negligence caused the outcome.
7) Probably the most important "monitoring instruments" for the clinician are diligent attention to the patient and the exercise of sound clinical judgment.

The American College of Legal Medicine Foundation (1991) recommends that umbilical cord blood sampling for pH and gas analysis be drawn for every delivery. This can substantiate that the baby was born in a good metabolic state and that intrapartum care was appropriate, or at least not related to a defective infant. Although the Foundation recommends this testing as a good defensive maneuver and an effective risk management technique, abnormal values may be ammunition for a litigant, even if the intrapartum monitoring was reasonable.

In the legal arena, it should be cogently argued that a serious neurologic defect in the offspring of a low risk pregnancy, that concluded with reasonable and documented intrapartum monitoring, with no substantial indication of fetal distress, must be scientifically and logically considered the result of a cause other than negligent delivery.

In the next issue, a case will be presented and discussed.

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REFERENCES

1. American College of Legal Medicine. Legal Medicine: Legal Definitions of Medical Encounters, 2d Ed St. Louis, MO: Mosby-Yearbook, Inc.; 1991.

2. American College of Legal Medicine Foundation. Medicolegal Primer. Pittsburgh, PA: Associates Litho, Inc.; 1991.

3. American College of Obstetricians and Gynecologists. Quality Assurance in Obstetrics and Gynecology. Wash-ington, DC: American College of Obstetricians and Gynecologists; 1989.

4. American College of Obstetricians and Gynecologists Committee on Obstetrics (Maternal-Fetal Medicine). Use and misuse of the Apgar score. ACOG Technical Bull. Nov 1986.

5. Apgar V. A proposal for a new method of evaluation of the newborn infant.Curr Res Anest Anal.1953; 32:260.

6. Beard RW. The detection of fetal asphyxia in labor. Pediatrics 1974; 53:157.

7. Bennett VR, Brown LK (eds). Myles' Textbook for Midwives, 11th Ed. New York, New York: Churchill-Livingstone; 1989.

8. Benson RC, et al. Fetal heart rate as a predictor of fetal distress. Obstet Gynecol. 1968; 32:259.

9. Cefalo RC (ed). Clinical Decisions in Obstetrics and Gynecology. Rockville, MD: Aspen; 1990.

10. Clark SL, Paul RH. Intrapartum fetal surveillance: The role of fetal scalp sampling. Am J Obstet Gynecol. 1985; 153:717.

11. Creasy RK, Resnik R (eds). Maternal-fetal medicine. Philadelphia, PA: W.B. Saunders CO; 1989.

12. Cunningham FG, et al. Williams Obstetrics (18th Ed.). East Norwalk, CT: Appleton and Lange (Prentice Hall); 1989.

13. Depp R. Normal labor and delivery and its conduct. In: Scott Jr, et al (eds). Danforth's Obstetrics and Gynecology, 6th ed. Philadelphia, PA: J.B. Lippincott Co.; 1990.

14. Gilstrap LC III, et al. Second-stage fetal heart rate abnormalities and type of neonatal acidemia. Obstet Gynecol. 1987; 70:191.

15. Haverkamp AD, et al. Evaluation of continuous fetal heart rate monitoring in high-risk pregnancy. Am J Obstet Gynecol. 1976; 125:310.

16. Haverkamp AD, et al. A controlled trial of the differential effects of intrapartum fetal monitoring. Am J Obstet Gynecol. 1979; 143:399.

17. Iams JD, et al (eds.). Manual of Obstetrics and Gynecology. St. Louis, MO: C.V. Mosby Co.; 1990.

18. Leveno KJ, et al. A prospective comparison of selective and universal electronic fetal monitoring in 34,995 pregnancies. NEJM 1986; 315:615-9.

19. Leveno KJ, Cunningham FG. Forecasting fetal health. In: Williams Supp. No. 19. East Norwalk, CT: Appleton and Lange; Aug/Sep 1988.

20. National Institutes of Health. Prenatal and Perinatal Factors Associated with Brain Disorders. Bethesda, MD: National Institutes of Health; 1985.Publication No. 85-149.

21. Ramin S, Gilstrap L. Medical-legal aspects of perinatal asphyxia. In: Cefalo RC (ed). Clinical Decisions in Obstetrics and Gynecology. Rockville, MD: Aspen; 1990.

22. Tucker SM. Pocket Nurse Guide to Fetal Monitoring. St. Louis, MO: C.V. Mosby Co.; 1988.

23. Zlatnik FJ. Clinical evaluation of fetal status. In: Scott JR, et al (eds). Danforth's Obstetrics and Gynecology, 6th ed. Philadelphia, PA: J.B. Lippincott Co.; 1990.